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(54) Optical module with connected optical fiber.

(57) This invention relates to an optical module having an optically operative device (2) to be optically connected to an optical fiber (1), and a fiber saddle (5) provided near the optically operative device (2) for the optical fiber (1) to be fixed to with solder. The fiber saddle (5) is provided on a heat insulative substrate (6) mounting the optically operative device (2), so that heat for melting the solder may not be dispersed through the fiber saddle (5), when the optical fiber (1) is soldered to the fiber saddle (5), and a necessary temperature for the soldering may be easily attained rapidly.

A fixation surface of the fiber saddle (5) is plated with solder, and a pre-formed structure (7) of solder is bridged over the optical fiber (1) positioned on the fixation surface, is melted and then solidified for the fixation of the optical fiber (1) to the fiber saddle (5), so that the optically operative device (2) is kept away from the contamination with a flux upon soldering of the optical fiber (1), and the dislocation of the optical fiber (1) is prohibited.

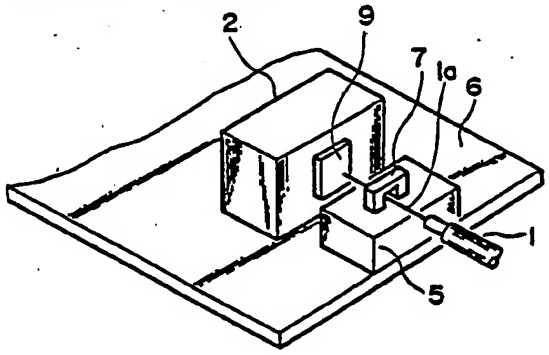

FIG.2

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An Optical Module

Present invention relates to an optical module for use in optical communication systems, such as data links, optical local area networks (LANs), wherein an optical fiber is to be connected to an optically operative device.

As such optical module there has been known an optical module comprising an optically operative device, such as semiconductor lasers, pin-photodiodes and others, and optical fibers optically connected to each other in a metal package.

In such optical module, the end of an optical fiber inserted in the package is soldered to a fiber saddle in the package, and the fiber saddle is molded in one piece with the package. A problem with such structure is that when a change is made to the shape or location of the fiber saddle, a new mold including that of the package has to be prepared, and consequently such structure is unadjustable to changes.

Another problem is that since the fiber saddle and the package are made of metal in one piece, the package adversely acts as a heat sink when the end of the optical fiber is soldered to the fiber saddle.

Accordingly it takes much energy and time to melt a solder on the fiber saddle. Consequently the workability is poor. Further another problem is that when the soldering is performed, a soldering flux is evaporated and sticks to the light emitting portion or receiving portion, smearing the same, and part of a solder which has not been melted due to insufficient heating touches the end of the optical fiber to dislocate it from its correct position. Furthermore, the end of the optical fiber is fixed to an incorrect position.

Therefore, main object of the present invention is to provide an optical module having a large allowance for changes in shapes and locations of a fiber saddle and which enables an optical fiber to be soldered to a fiber saddle in a short period of time.

Furthermore, the optical fiber should be secured presicely in respect to an optically operative device and contamination by soldering flux should be prevented.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. These objects are accomplished by an optical module according claims 1 and 2 and a method for fixation an optical fiber according claim 10.

Brief Description of the Drawings

Fig. 1 is a perspective view of a major part of the optical module according to one embodiment of this invention;

Fig. 2 is a partial perspective view of the embodiment of Fig. 1 for explaining fixation of an optical fiber;

Fig. 3 is a front view of the embodiment of Fig. 1;

Figs. 4 and 5 are front views of modifications of the pre-formed structure other than those respectively shown in Figs. 2 and 3.

Description of the Preferred Embodiments

In an optical receiving module according to one embodiment of present invention, as shown in Fig. 1, in a metal package 3 there is provided a hybrid integrated circuit (IC) substrate 6 having a required circuit not shown. Openings are formed in side walls of the package 3. Through the openings an electric signal line 8 and an optical fiber 1 are inserted in the package 3.

The optical fiber 1 is optically connected to a pin-photodiode not shown provided on a side of a carrier chip 2, and a light emitted from the end of the optical fiber 1 is incident on the light receiving portion of the pin-photodiode as a light receiving device.

The optical fiber 1 has the end 1a made of the so called metallized fiber which comprises exposed glass fiber and a plating applied thereto. The end 1a of the optical fiber 1 is first positioned precisely on a fiber saddle 5 disposed near the carrier chip 2 and then soldered to the fiber saddle 5.

The hybrid IC substrate 6 is made of a heat insulative material, e.g., ceramics or others. The carrier chip 2 is mounted on the hybrid IC chip 6 as one element of the circuit. The fiber saddle 5 is made of metal or ceramics vacuum evaporated with metal and is beforehand plated with a solder. The fiber saddle 5 is die bonded to the hybrid IC substrate 6 with a solder having a relatively high melting point, e.g., gold and tin (Au-Sn} solder with a melting point of 280° C.

After a cream solder is applied around the fiber saddle 5, the fiber saddle 5 is mounted on the hybrid IC substrate 6 and then heated. It is possible that the plating and die bonding of the fiber saddle 5 are performed simultaneously.

Next, the fixation of the end 1a of the optical fiber 1 to the fiber saddle 5 will be explained with reference to Figs. 2 and 3.

The end 1a of the optical fiber 1 is positioned so as to be optically connected to the pin-

photodiode 9 on the front side wall of the carrier chip 2. Concavities 5a are formed on the top of the fiber saddle 5. In the concavities 5a are inserted the legs of a pre-formed structure 7 bridged over the end 1a of the optical fiber 1 positioned on the top of the fiber saddle 5. The preformed structure 7 is made of a solder containing no flux and is shaped in a square bracket. It is preferable that the solder of the pre-formed structure 7 has lower melting point than that used to die bond the fiber saddle 5. The end 1a of the optical fiber 1 is plated beforehand into a metallized fiber so as to be convenient for the soldering.

The pre-formed structure 7 and the fiber saddle 5 as arranged in the above described manner are heated. When the heating temperature becomes above the melting point of the pre-formed structure 7, the pre-formed structure 7 melts. Then the heating is stopped. The melted preformed structure 7 cools and solidifies, and the end 1a of the optical fiber 1 is fixed to the fiber saddle 5.

The end 1a of the optical fiber 1 may be positioned on the top of the fiber saddle 5 after the legs of the pre-formed structure 7 is inserted fixedly in the concavities 5a and then the end 1a of the optical fiber 1 is put into the gap between the preformed structure 7 and the fiber saddle 5.

In this embodiment, the pre-formed structure 7 has a square bracket shape before melted but may have a U-shape or an L-shape as shown in Figs. 4 and 5.

Finally, a top cover not shown is attached to the package for close sealing, and the optical module is completed.

In this embodiment, two legs of the pre-formed structure 7 are inserted in the concavities 5a respectively. But the pre-formed structure may have a J-shape in which the two legs have different lengths, and only one of the two legs is inserted in the concavity 5a. In this case rhe concavity 5a may be one. And fiber saddle may not have cocavities. In this case the pre-formed structure can be placed on the fixation surface to be bridged over the optical fiber positioned on the fixation surface.

This embodiment is a receiving optical module comprising a pin-photodiode as a light receiving device, and an optical fiber optically connected to the light receiving device. But the optical module according to this invention can be a transmitting optical module by replacing the light receiving device with a light emitting diode or a laser diode as a light emitting device.

From the invention thus described, it will be obvious that the invention may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

Claims

1. An optical module having:
a package (3) housing an optically operative device (2); an optical fiber (1) whose end (1a) is inserted in the package (3) and optically connected to the optically operative device (2); and
a fiber saddle (5) for fixing the optical fiber (1) characterized in that
the fiber saddle (5) is mounted on a heat insulative substrate (6).

2. An optical module having:
an optically operative device (2) to be optically connected to an optical fiber (1); and
a fiber saddle (5) which the optical fiber (1) is fixed to and is provided near the optically operative device (2) the optical fiber (1) being fixed to the fiber saddle (5) by solder,
characterized in that,
the fixation of the optical fiber (1) to the fiber saddle (5) being performed by melt and solidification of a preformed structure (7) made of solder and bridged over the optical fiber (1) positioned on the fiber saddle (5).

3. An optical module according to claim 1 or 2, wherein the optically operative device (2) is mounted on the heat insulative substrate (6) together with the fiber saddle (5).

4. An optical module according to claim 1 or 2, wherein the fiber saddle (5) is made of ceramics having the surfaces vapor evaporated with metal.

5. An optical module according to claim 1 or 2, wherein the heat insulative substrate (6) is made of ceramics.

6. An optical module according to claim 1 or 2, wherein the optically operative device (2) is a light receiving device.

7. An optical module according to claim 1 or 2, wherein the optically operative device (2) is a light emitting device.

8. An optical module according to claim 2, wherein the preformed structure (7) contains no flux.

9. An optical module according to claim 6, wherein the fiber saddle (5) have one or more concavities (5a) for inserting of the pre-formed structure (7).

10. Method of fixing an optical fiber to a fiber saddle provided near a optically operative device, comprising the steps:
- plating the fixation surface of the fiber saddle with solder
- positioning the optical fiber to the fiber saddle

- positioning a pre-formed structure made of solder over the optical fiber
- melting and solidifying the pre-formed structure.

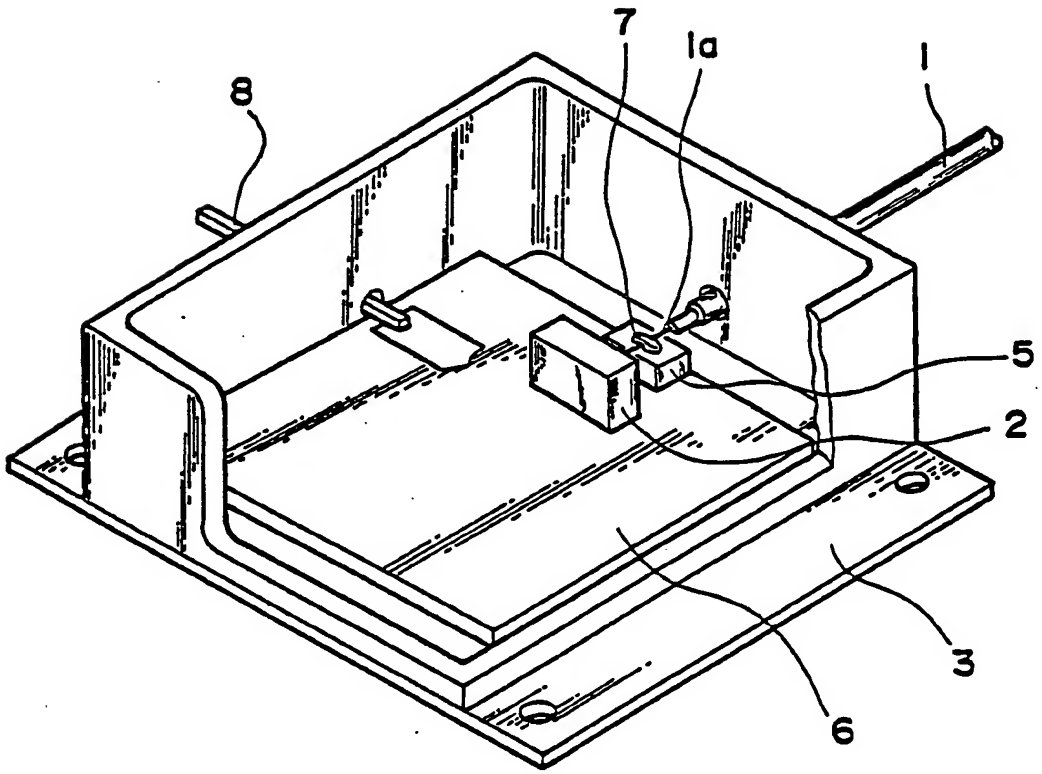

FIG. 1

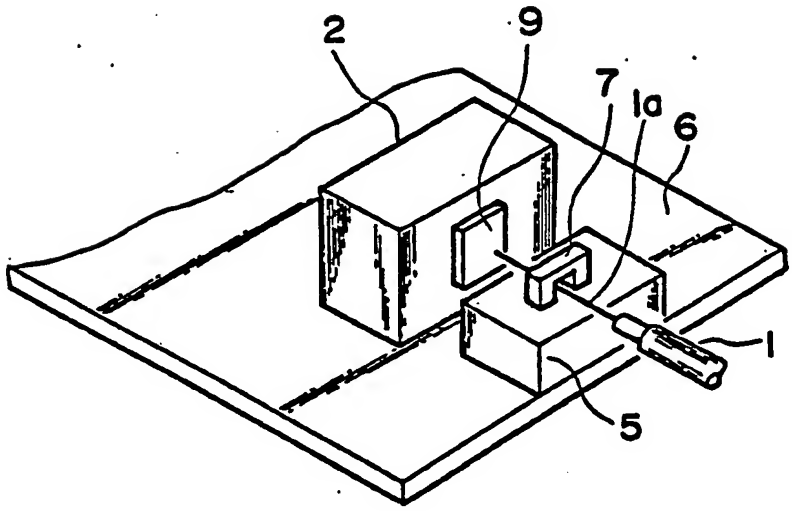

FIG. 2

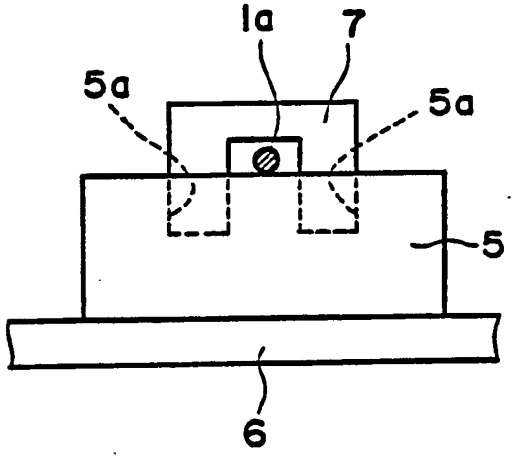

FIG. 3

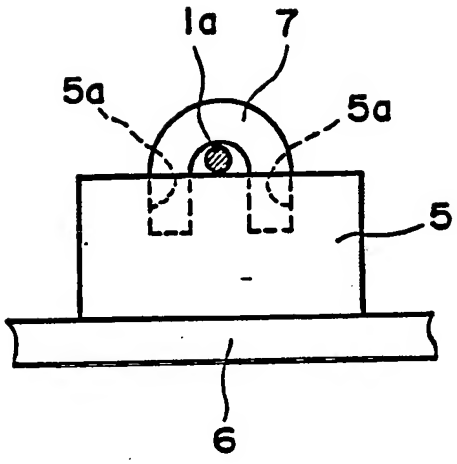

FIG.4

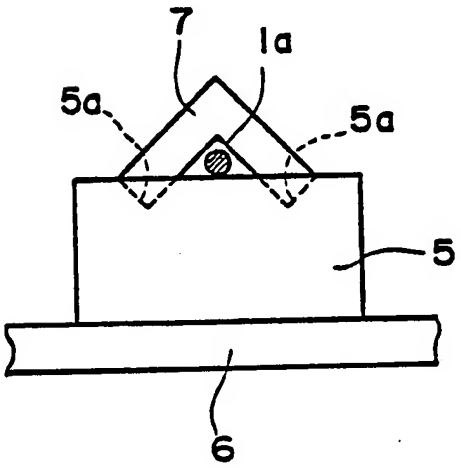

FIG.5